## Space Weather Technical Forecast

Issued on Thursday 9 January 2025 at 00:14 Local

**This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales**

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**Space Weather Forecast Headline: Chance of isolated M-class flares. Active electron fluence expected Day 1 (09 Jan).**

**Analysis of Space Weather Activity over past 24 hours**

**Solar Activity:** Low with no significant flares. There are eight regions currently visible on the Earth-facing disc, with only one notable region AR3947, now in the northwest. This remains moderately sized with a complex magnetic structure including a weak delta-spot amongst the intermediate portion of the group, although flare activity in the last 24 hours has significantly waned from previous days. AR3950 in the southeast, although small and magnetically simple, produced a C9.9 flare at 08/0637 UTC. The other regions across the disc are all small and simple, and either stable or showing signs of decay.

No Earth-directed CMEs were observed, with those visible in current imagery off the Earth-Sun line.

**Solar Wind / Geomagnetic Activity:** The fast wind from CH05/+ continues to ease after a weak and glancing CME arrival evident between 07/0430-1250 UTC, likely due to the passing of the shockwave of the eruption from AR3939 on 04 Jan. Solar wind speeds were initially slightly elevated at 490km/s but quickly began to trend down, with speeds near 400km/s by the end of the period. The Interplanetary Magnetic Field, Bt, remained weak and steady around 5-6nT throughout. The north-south component, Bz, was variable between +/-5nT, but slightly favoured a southward direction. Phi angle was positive (away from the Sun). Geomagnetic activity was initially Active (Kp4) between 08/0000-0300 UTC, then falling to Quiet (Kp1-2).

**Energetic Particles / Solar Radiation:** High energy proton flux (greater than 10MeV) at GOES-18 was near background. High energy electron flux (greater than 2MeV) at GOES16 was initially Moderate before becoming High from 08/1320UTC peaking at 1550 pfu at 08/1450 UTC. The associated 24 hour fluence rose in response, to be just under the Active threshold for most of the period before dropping back to 6.78e7 integrated pfu at 08/2359UTC.

**Four-Day Space Weather Forecast Summary**

**Solar Activity:** Low with an ongoing chance of isolated M-class flares.

**Solar Wind / Geomagnetic Activity:** There are no Earth-directed CME's. Current slightly elevated solar winds from CH05/+ are expected to continue erratically easing through Day 1 (09 Jan)

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towards background, before a further brief enhancement is likely from CH07/+ fast winds on Days 2-3 (10-11 Jan). Geomagnetic activity is expected to be mostly Quiet with isolated Unsettled intervals. There is a chance of this increasing to Unsettled to Active with a slight chance of G1/Minor Storm intervals with any fast wind onset.

**Energetic Particles / Solar Radiation:** GOES18 high energy proton flux is near background with a slight chance of further Solar Radiation Storms as AR3947 moves into the western hemisphere. GOES 16 high energy electron flux is forecast to continue at Moderate to High, perhaps becoming mainly High with the associated 24 hour fluence expected to rise above the Active level on Day 1 (09 Jan). This is likely to persist at this level, but with a decreasing confidence, especially from Day 3 (11 Jan) onward with any further fast wind onset.

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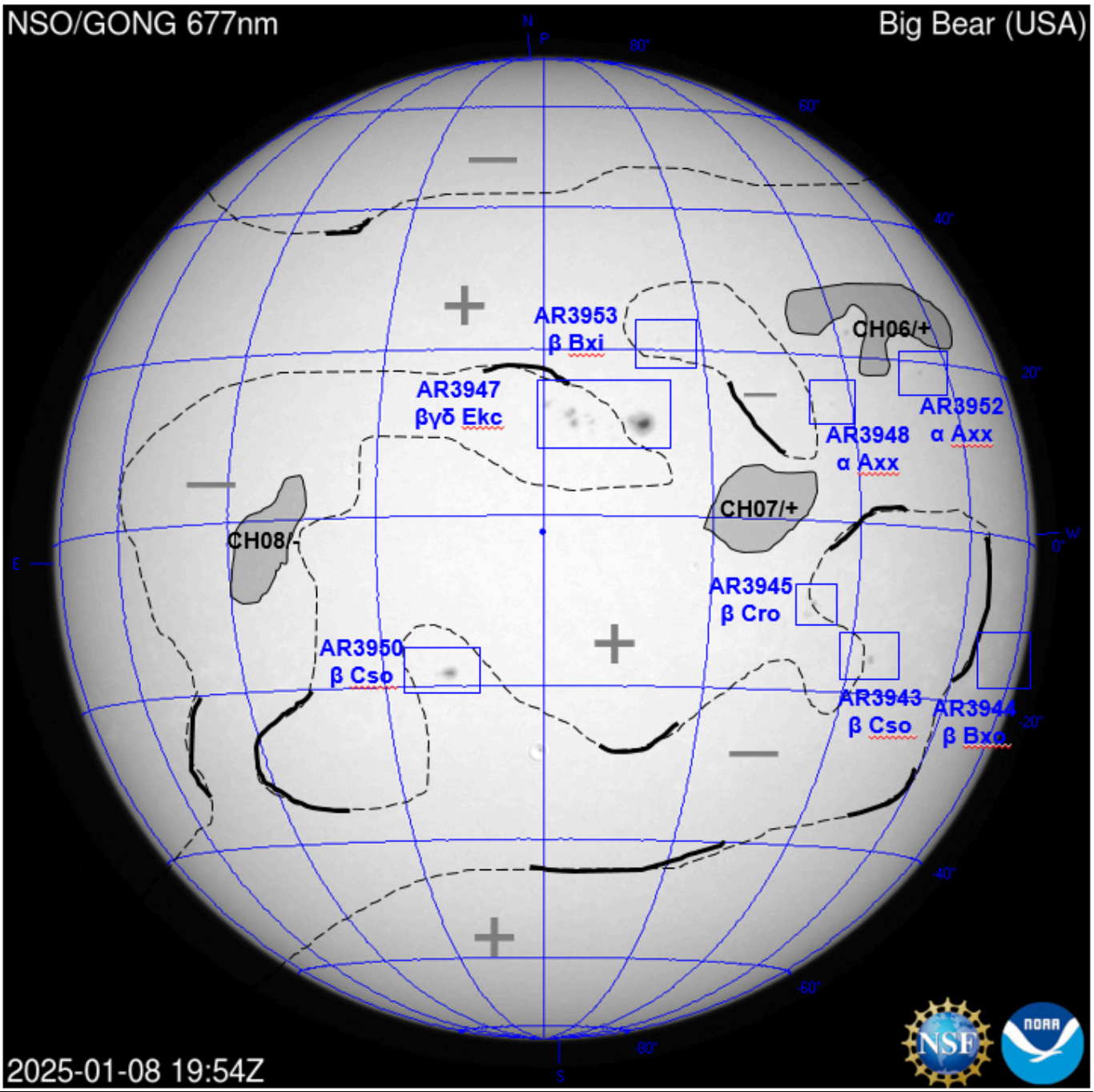
**Figure 1: Solar Synoptic map Vt 08/2000UTC**




**Key:** Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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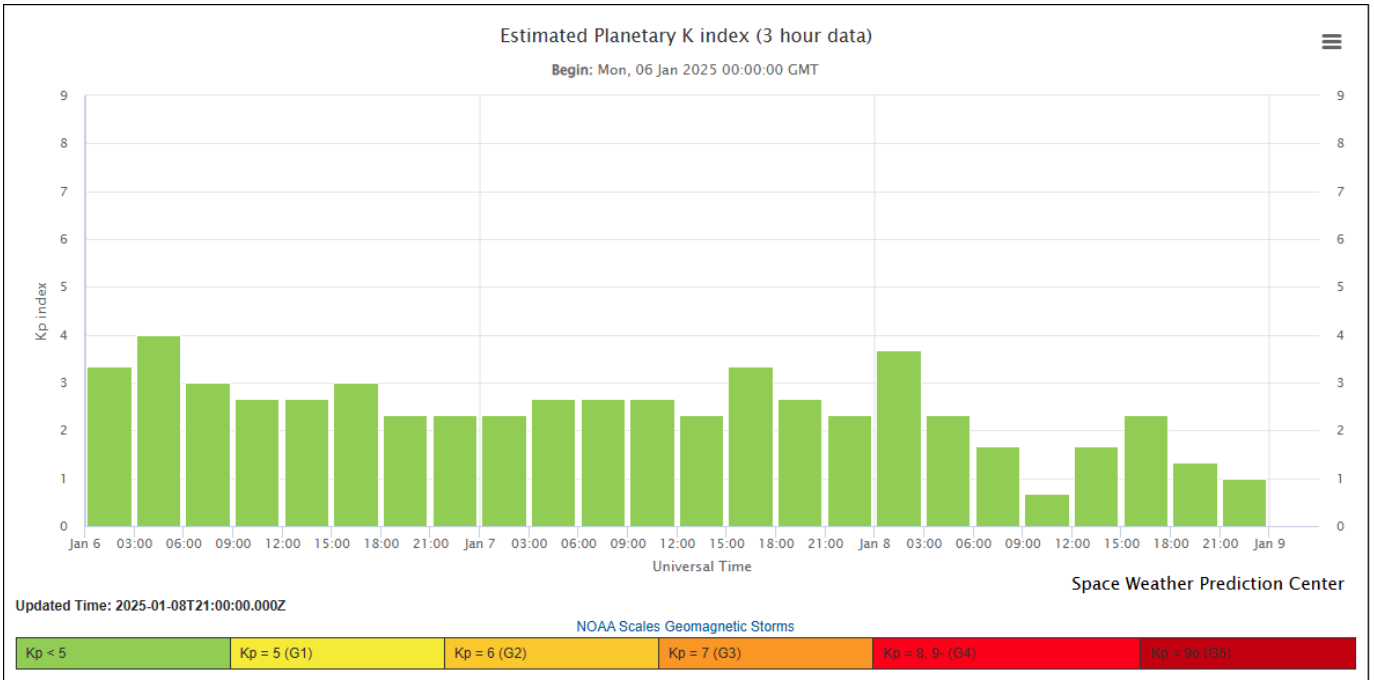
## Geomagnetic Storms

There are no Earth-directed CME's. Current slightly elevated solar winds from CH05/+ are expected to continue erratically easing through Day 1 (09 Jan) towards background, before a further brief enhancement is likely from CH07/+ fast wind on Days 2-3 (10-11 Jan). Geomagnetic activity is expected to be mostly Quiet with isolated Unsettled intervals. There is a chance of this increasing to Unsettled to Active with a slight chance of G1/Minor Storm intervals with any fast wind onset.

| Geomagnetic Storm Probability (Exceedance) | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| Minor or Moderate | G1 to G2 | No | 1 | 5 | 5 | 5 |
| Strong | G3 | No | 1 | 1 | 1 | 1 |
| Severe | G4 | No | 1 | 1 | 1 | 1 |
| Extreme | G5 | No | 1 | 1 | 1 | 1 |

**Figure 2: SWPC Estimated Planetary K index**


Estimated Planetary K index (3 hour data)
Begin: Mon, 06 Jan 2025 00:00:00 GMT
Kp index
Jan 6 03:00 06:00 09:00 12:00 15:00 18:00 21:00 Jan 7 03:00 06:00 09:00 12:00 15:00 18:00 21:00 Jan 8 03:00 06:00 09:00 12:00 15:00 18:00 21:00 Jan 9
Universal Time
Space Weather Prediction Center
Updated Time: 2025-01-08T21:00:00.000Z
NOAA Scales Geomagnetic Storms
Kp < 5
Kp = 5 (G1)
Kp = 6 (G2)
Kp = 7 (G3)
Kp = 8, 9- (G4)
Kp = 9o (G5)

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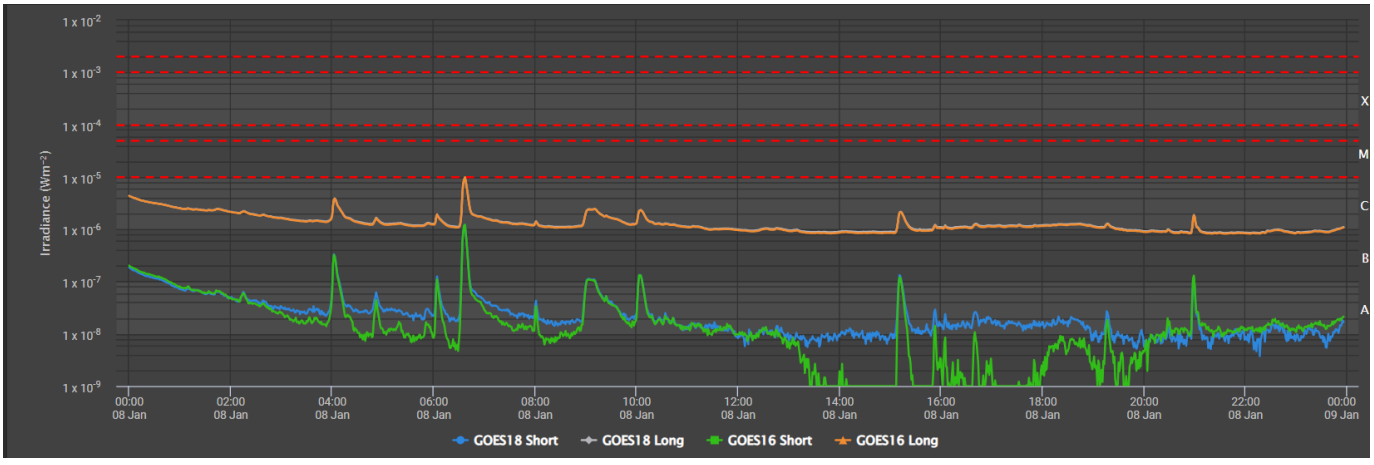
## Radio Blackouts - X-Ray Flares

Low activity is expected to continue with a chance of isolated M-class flares possible, mainly from AR3947, which is the only notable sunspot group of the eight currently on the Earth-facing disc.

AR3947 has been the source of much of the recent activity, including the X-class flares on the previous days, the region remains moderately sized with a complex magnetic structure including a weak delta-spot amongst the intermediate portion of the group. Although this has been difficult to confidently identify due to its weak appearance. However activity from this region in the last 24 hours has some what dwindled. The peak C9.8 flare at 08/0637 UTC appears to have originated from AR3950, a small, and magnetically simple Cso group in the southeast. Across the rest of the disc, the other regions are all very small and simple, and either stable or showing some sign of decay.

| X-Ray Flares Probability | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| Active | R1-R2 (M Class) | No | 50 | 50 | 50 | 50 |
| Very Active | R3-R5 (X Class) | No | 10 | 10 | 10 | 10 |

**Figure 3: GOES16 X-Ray flux**

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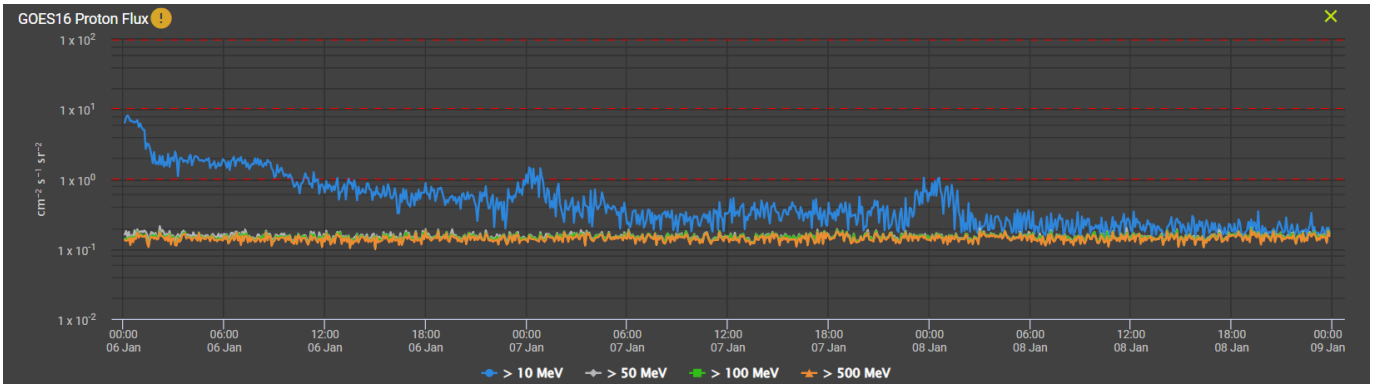
## Solar Radiation Storms (High Energy Protons)

GOES18 high energy proton flux is now near background, having eased after the recent enhancement. The source of this enhancement AR3939 is now onto the far-side, with a decreasing potential to erupt high energy protons that can be observed at Earth. However a slight chance of further enhancement is maintained due AR3947 which is now in the western hemisphere. While it has shown a reduction in activity in the last 24 hours, it will continue to provide a chance of further flares as this moves further into the western hemisphere, which is a better location for observable high energy protons at Earth. Furthermore, there are a number of filaments currently on the disc, and it is not impossible that a large eruption from any of these could result in Earth-directed high energy protons.

| Radiation Storms Probability (Exceedance) | Level ($cm^{-2}sr^{-1}s^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| **Active** | **≥ S1** | No | 10 | 10 | 10 | 10 |
| **Very Active** | **≥ S3 *** | No | 1 | 1 | 1 | 1 |
| * S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$) | | | | | | |

**Figure 4: Three day Solar radiation plot**

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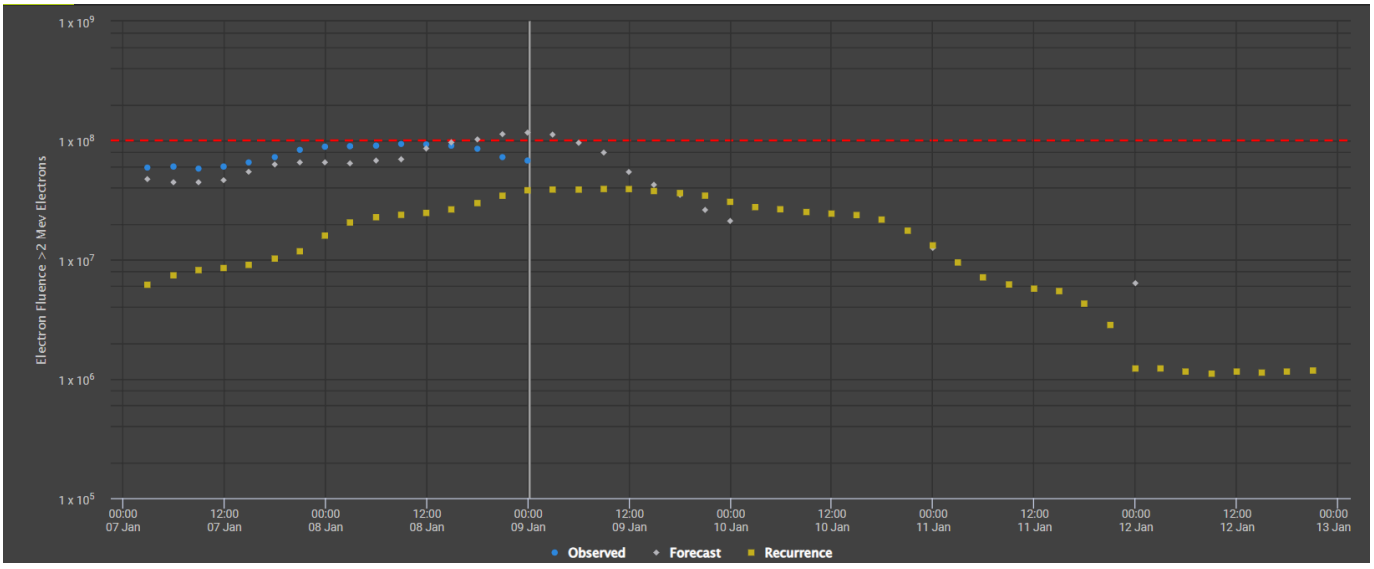
## High Energy Electrons (≥ 2MeV)

High energy electron flux observed at GOES16 climbed from Moderate to High values between 08/1320UTC and 08/2125UTC, peaking at 08/1450UTC with 1500 pfu. This is as a result of solar winds now gradually easing, after the combined effect of the fast wind enhancement from CH05 and recent weak glancing CMEs. This sequence of events would have led to the charging of the Van Allen Belts, albeit at lower orbital levels, and then as solar winds ease, the radiation belts have then expanded back to incorporate GEO. Subsequently the observed flux has risen, and is likely to remain at moderate to diurnally high for days 1 and 2 (09-10 Jan) at least. The main suppression is likely to come from any weak influence of the fast wind from CH07, most likely on Day 2 (10 Jan).

Fluence is currently near the Active threshold, albeit with a declining trend. This is expected to rise above the Active threshold on Day 1 (09 Jan), with a decreasing confidence of then persisting above, especially Day 3 (11 Jan) onward due to any potential fast wind onset. This initial rising trend is supported by REFM, however this maybe slightly underestimating expected values.

| GEO Electron Environment | Level ($cm^{-2}sr^{-1}$ $day^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) | Day 2 (00-24 UTC) | Day 3 (00-24 UTC) | Day 4 (00-24 UTC) |
|---|---|---|---|---|---|---|
| Probability (Exceedance) | | | (%) | (%) | (%) | (%) |
| Active | ≥ 2 MeV ≥ $1\times10^{8}$ | No | 80 | 60 | 30 | 30 |
| Very Active | ≥ 2 MeV ≥ $1\times10^{9}$ | No | 1 | 1 | 1 | 1 |

**Figure 5: MOSWOC REF Model**

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